

WHAT IS CLAIMED IS:

1. A method for sealingly joining a graft vessel to a target vessel at an anastomosis site,  
 5 the target vessel having an opening formed therein, comprising the steps of:

positioning a fastener made from a deformable material radially adjacent a free  
 end portion of said graft vessel, said material being transformable between a non-fluent  
 state and a fluent state, upon application of energy to the material;

10 inserting at least said free end portion of said graft vessel in said target vessel  
 through the opening in the target vessel;

supplying energy to the deformable material at an intensity sufficient to transform  
 15 the material into said fluent state;

radially expanding at least said free end portion of said graft vessel to expand the  
 graft vessel into intimate contact with an inner wall of said target vessel; and

20 discontinuing the energy supply so that the material returns to its non-fluent state  
 to sealingly secure the graft vessel to the target vessel.

2. The method of claim 1 wherein said energy is selected from a group consisting of  
 radiant energy, convection heating, conduction heating, light energy, radiofrequency  
 25 energy, microwave energy, and ultrasonic energy.

3. The method of claim 1 wherein said deformable material is selected from a group  
 consisting of polymeric, polymers, and copolymers.

4. The method of claim 3 wherein said deformable material is selected from a group  
 30 consisting of polyglycolic/polylactic acid (PGLA) polymer, polyhydroxybutylate

valerate (PHBV) polymer, polycaprolactone (PCL) polymer, polycaprolactone homopolymer, and polycaprolactone copolymers.

5. The method of claim 1 wherein said material is bioerodable.
6. The method of claim 1 further comprising the step of everting at least a first portion of said free end portion of the graft vessel over a portion of said fastener prior to said step of inserting the graft vessel in the target vessel.
7. The method of claim 6 wherein the step of everting comprises attaching the first portion of said free end portion of the graft vessel to the fastener.
8. The method of claim 7 wherein the step of attaching the graft vessel to the fastener comprises suturing the graft vessel to the fastener.
9. The method of claim 7 wherein the step of attaching the graft vessel to the fastener comprises applying an adhesive material to an external surface of said first portion of said free end portion of the graft vessel.
10. The method of claim 7 wherein said deformable material has an adhesive surface and the step of attaching the graft vessel to the fastener comprises adhering the first portion of the free end portion of the graft vessel to the fastener.
11. The method of claim 1 wherein said supplying energy step comprises positioning a distal end portion of a light-diffusing balloon catheter in said graft vessel.
12. The method of claim 1 wherein said supplying energy step comprises positioning a distal end portion of a thermal balloon catheter in said graft vessel.
13. The method of claim 11 wherein said supplying energy step further comprises irradiating said deformable material with light energy from an energy source which is coupled to a light-diffusing end member of said catheter via at least one optical fiber.

14. The method of claim 13 wherein said radially expanding step comprises inflating a balloon of said balloon catheter.

15. The method of claim 1 wherein said supplying energy step comprises positioning a distal end portion of a light-diffusing catheter in said graft vessel.

16. The method of claim 15 wherein said supplying energy step further comprises irradiating said deformable material with light energy from an energy source which is coupled to a light-diffusing end member of said catheter via at least one optical fiber.

17. The method of claim 1 wherein said radially expanding step comprises inflating a balloon of a balloon catheter.

18. The method of claim 1 wherein said supplying energy step comprises exposing said material to energy having a wavelength of between 100 nm and 15,000 nm.

19. The method of claim 1 wherein said supplying energy step comprises exposing said material to energy having a wavelength of between 300 nm and 1100 nm.

20. The method of claim 1 wherein said fastener positioning step comprises positioning a tubular sleeve of said deformable material over an external surface of said free end portion of said graft vessel.

21. The method of claim 1 wherein said fastener positioning step comprises rolling a thin sheet of said deformable material over an external surface of said free end portion of said graft vessel.

22. The method of claim 1 wherein said fastener positioning step comprises longitudinally inserting a tubular sleeve of said deformable material within an opening in said free end portion of said graft vessel.

23. The method of claim 1 wherein said radially expanding step is performed prior to said energy supplying step.

5 24. The method of claim 1 wherein the material is impregnated with one or more agents selected from the group consisting of anti-platelet, anti-thrombus, and anti-inflammatory compound.

10 25. The method of claim 1 wherein the material utilized is impregnated with one or more anti-proliferative compounds.

26. A method for sealingly joining a graft vessel to a target vessel at an anastomosis site, the target vessel having an opening formed therein, comprising the steps of:

15 applying a coating of a curable material to a free end portion of said graft vessel, said material being transformable between a fluent state and a non-fluent state upon application of energy to the material;

20 inserting at least said free end portion of said graft vessel in said target vessel through the opening in the target vessel;

radially expanding at least said free end portion of said graft vessel to expand the graft vessel into intimate contact with an inner wall of said target vessel; and

25 supplying energy to the material at an intensity sufficient to transform the material into its non-fluent state to sealingly secure the graft vessel to the target vessel.

27. The method of claim 26 wherein said material is bioerodable.

30 28. The method of claim 26 wherein said material is selected from a group consisting of polyethylene-glycol (PEG) based hydrogel, acrylate, and acrylated urethane.

29. The method of claim 26 wherein said coating comprises a liquid.
30. The method of claim 26 wherein said coating comprises a viscous gel.
31. The method of claim 26 wherein the material is impregnated with one or more agents  
5 selected from a group consisting of anti-platelet, anti-thrombus, and anti-inflammatory compounds.
32. The method of claim 26 wherein the material utilized is impregnated with one or  
10 more anti-proliferative compounds.
33. The method of claim 26 further comprising the step of everting at least a first portion  
of said free end portion of the graft vessel over a portion of said coating.
34. The method of claim 33 further comprising the step of coupling said first portion of  
15 said free end portion to said coating.
35. The method of claim 34 wherein said coupling step includes suturing said first  
portion to said graft vessel.
36. The method of claim 34 wherein said curable material has an adhesive surface and  
20 wherein said coupling step comprises adhering said first portion to said coating.
37. The method of claim 26 wherein said supplying energy step comprises positioning a  
distal end portion of a light-diffusing balloon catheter in said graft vessel.
38. The method of claim 37 wherein said supplying energy step further comprises  
25 irradiating said material with light energy from an energy source which is coupled to  
a light-diffusing end member of said catheter via at least one optical fiber.
39. The method of claim 37 wherein said radially expanding step comprises inflating a  
30 balloon of said balloon catheter.

40. The method of claim 26 wherein said supplying energy step includes the step of positioning a distal end portion of a light-diffusing catheter in said graft vessel.

5 41. The method of claim 40 wherein said supplying energy step further comprises irradiating said material with light energy from an energy source which is coupled to a light-diffusing end member of said catheter via at least one optical fiber.

10 42. The method of claim 26 wherein said radially expanding step comprises inflating a balloon of a balloon catheter.

43. The method of claim 26 wherein said supplying energy step comprises exposing said curable material to ultraviolet radiation from an ultraviolet radiation energy source.

15 44. The method of claim 26 wherein said supplying energy step comprises exposing said curable material to visible light from a visible light energy source.

45. The method of claim 26 wherein said supplying energy step comprises exposing said curable material to infrared radiation from an infrared radiation energy source.

20 46. An anastomosis device for use in coupling an end of a first vessel to a side of a second vessel in an anastomosis, the device comprising a tubular member formed of a deformable material, and a graft vessel connected to the tubular member, the tubular member being transformable upon application of energy to the tubular member between a non-fluent state and a fluent state in which the tubular member is radially expandable to sealingly engage the graft vessel with the target vessel.

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47. The anastomosis device of claim 46 wherein the tubular member is pre-shaped and has at least a first bend along a length of the member.

30 48. The anastomosis device of claim 47 wherein the portion of the tubular member extends at an angle of between 30° and 90° relative to the longitudinal centerline.

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49. The anastomosis device of claim 46 wherein said tubular member is formed from a biocompatible material.

5 50. The anastomosis device of claim 49 wherein said biocompatible material is bioerodable.

51. The anastomosis device of claim 46 wherein said biocompatible material comprises a polymeric material.

52. The anastomosis device of claim 51 wherein said polymeric material is selected from a group consisting of a polymer, a homopolymer, and a copolymer.

53. The anastomosis device of claim 52, wherein the polymeric material is a polycaprolactone.

15 54. The anastomosis device of claim 46 wherein an end portion of the graft vessel is everted over an end margin of the tubular member.

55. The anastomosis device of claim 54 wherein the tubular member has an adhesive surface and the end portion of the graft vessel is adhered to the tubular member.

20 56. The anastomosis device of claim 49 wherein the tubular member includes a chromophore.

57. The anastomosis device of claim 56 wherein said chromophore is a dye.

25 58. The anastomosis device of claim 46 wherein said tubular member is impregnated with one or more agents selected from the group consisting of anti-platelet, anti-thrombus, and anti-inflammatory compounds.

59. The anastomosis device of claim 46 wherein the tubular member is impregnated with one or more anti-proliferative compounds.

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5 60. A fastener for sealingly joining a graft vessel to a target vessel in an anastomosis, the target vessel having an opening formed in a side wall thereof, the fastener comprising a tubular member formed of a deformable material and sized and dimensioned for receiving an end portion of said graft vessel, said tubular member being transformable upon application of energy to the tubular member between a non-fluent state in which said tubular member has an outer diameter smaller than the opening in the target vessel, and a fluent state in which said tubular member is radially  
10 expandable to permit said graft vessel to be forced into sealing engagement with an inner wall of the target vessel.

61. An anastomosis device for coupling a graft vessel to a target vessel, the device comprising a graft vessel having a material disposed on an end margin of a free end  
15 thereof, the material being transformable upon the application of energy to the material between a fluent state in which the material is radially expandable to permit radial expansion of the graft vessel, and a non-fluent state in which the material retains the end margin of the graft vessel in its expanded state in sealing engagement with the target vessel.

20 62. The fastener of claim 61 wherein said material is bioerodable.

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25 63. The fastener of claim 61 wherein said material is selected from a group consisting of polyethylene-glycol (PEG) based hydrogels, acrylates, and acrylated urethanes.

64. The fastener of claim 61 wherein the material is impregnated with an agent selected from the group consisting of anti-platelet, anti-thrombus, and anti-inflammatory compounds.

30 65. The fastener of claim 61 wherein the material is impregnated with one or more anti-proliferative compounds.



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- 5 67. The fastener of claim 61 wherein said material is applied to an inner wall of the graft vessel.